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EXAMINER	
DOBSON, DANIEL G	

ART UNIT	PAPER NUMBER
2613	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/588,042	ZHENGFU ET AL.	
	Examiner	Art Unit	
	DANIEL G. DOBSON	2613	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE _3_ MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on _01 August 2006_.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) _1-12_ is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) _1-12_ is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on _01 August 2006_ is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application

6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

2. Claims 1-7, 9, and 10 are rejected under 35 U.S.C. 102(b) as being anticipated by U.S. Patent 6,438,234 B1 to Gisin et al.

As to **Claim 1**, *Gisin* discloses a polarization-controlled encoding method comprising the steps of:

splitting an injected optical pulse into two optical pulses traveling along two different paths (Fig. 1, splitter (41) of interferometer (4) splits pulses from source (40) into the top path (43) and bottom path (42));

relatively delaying said two optical pulses (Fig. 1, delay (43) on top path of interferometer (4));

recombining the delayed pluses in one output path (Fig. 1, coupler (44) recombines the pulses split by splitter (41)); and

phase modulating at least one pulse after said splitting step or recombining step according to a quantum key distribution protocol (Fig. 1, modulator (42) phase modulates one pulse split by splitter (41); Col. 2, ll. 40-2, information about the key is encoded by phase modulator (42)),

wherein said method further comprises a step of controlling the polarization states of two pulses during the course from the splitting to the recombining to make said polarization states same after recombining before output (Col. 2, ll. 56-8, both interferometers preserve polarization.)

As to **Claim 2**, *Gisin* discloses keeping said polarization states of two optical pulses fixedness during the course from the splitting to the recombining (Col. 2, ll. 56-8, both interferometers preserve polarization.)

As to **Claim 3**, *Gisin* discloses making said two optical pulses reflected odd times by 90 degree Faraday mirrors separately, and passing them through the same path even times respectively (Fig. 2, pulses are reflected by mirror (22) one time and pass through splitter (20) twice.)

As to **Claim 4**, *Gisin* discloses making one optical pulse outputted directly and another optical pulse reflected even times by 90 degree Faraday mirrors, and passing the reflected pulse through the same path even times (Fig. 2, interferometer (1) sends one pulse from source (10) directly to fiber (3) while another pulse is reflected once by each Faraday mirror (14) and (16).)

As to **Claim 5**, *Gisin* discloses a first polarization-maintained beam splitter for splitting an optical pulse into two optical pulses traveling along two different paths (Fig. 1, splitter (41) of interferometer (4) splits pulses from source (40) into the top path (43) and bottom path (42));

a delay line for relatively delaying said two optical pulses (Fig. 1, delay (43) on top path of interferometer (4));

a second polarization-controlled beam splitter for recombining the delayed pluses in one output path (Fig. 1, coupler (44) recombines the pulses split by splitter (41)); and

a phase modulator arranged on at least one path of said two different paths and said output path (Fig. 1, modulator (42) phase modulates one pulse split by splitter (41)),

wherein said two different paths are polarization-maintained paths (Col. 2, ll. 56-8, both interferometers preserve polarization.)

As to **Claim 6**, *Gisin* discloses a polarization-maintained beam splitter for splitting an optical pulse into two optical pulses traveling along two different paths (Fig. 2, interferometer (1) sends one pulse from source (10) directly to fiber (3) while another pulse is reflected once by each Faraday mirror (14) and (16));

a polarization-maintained delay line arranged on one of said two different paths for relatively delaying said two optical pluses (Fig. 2, path by second pulse (traversing both mirrors) is delayed with respect to the first pulse directly output);

at least one mirror for reflecting the delayed pluses to the polarization-maintained beam splitter to recombine the delayed pulses in one output path (Fig. 2, mirrors (14 and 16) reflect the delayed pulse to be combined with the pulse directly transmitted); and

a phase modulator arranged on at least one of said two different paths and said output path (Fig. 2, 13),

wherein said two different paths are polarization-maintained paths (Col. 4, ll. 35-40.)

As to **Claim 7**, *Gisin* discloses a beam splitter for splitting an optical pulse into two optical pulses traveling along two different paths (Fig. 2, interferometer (1) sends one pulse from source (10) directly to fiber (3) while another pulse is reflected once by each Faraday mirror (14) and (16));

a delay line arranged on one of said two different paths for relatively delaying said two optical pluses (Fig. 2, path by second pulse (traversing both mirrors) is delayed with respect to the first pulse directly output);

two 90 degree Faraday mirrors for respectively reflecting the delayed pluses back said beam splitter to recombine the delayed pulses in one output path (Fig. 2, mirrors (14 and 16) reflect the delayed pulse to be combined with the pulse directly transmitted); and

a phase modulator arranged on at least one of said different paths and said output path (Fig. 2, 13.)

As to **Claim 9**, *Gisin* discloses a beam splitter for splitting an optical pulse into two optical pulses traveling along two different paths and outputting one optical pulse directly (Fig. 2, interferometer (1) sends one pulse from source (10) directly to fiber (3) while another pulse is reflected once by each Faraday mirror (14) and (16));

a first 90 degree Faraday mirror for reflecting another optical pulse back said beam splitter and passing it through said beam splitter (Fig. 2, 14) ;

a second 90 degree Faraday mirror for reflecting the pulse passed through said beam splitter back (Fig. 2, 16),

wherein said beam splitter recombines the reflected pulse with the outputted pulse in one output path (Fig. 2, double reflected pulse is combined with direct pulse by splitter (12) and then transmitted on fiber (3));

a delay line arranged on the paths between the first and second mirrors (Fig. 2, the path between the mirrors is longer than the path taken by the direct pulse); and

a phase modulator arranged on at least one of said paths between the first and second mirrors and said output path (Fig. 2, 13.)

As to **Claim 10**, *Gisin* discloses a quantum key distribution system comprising (Fig. 1):

a transmitter side polarization-controlled encoder for splitting an optical pulse emitted from a pulse light source into two optical pulses traveling along two different paths (Fig. 1, polarization preserving interferometer (4) splits (41) the pulses into two paths),

relatively delaying said two optical pulses and recombining said optical pulses in one output path (Fig. 1, pulse that traverses path (43) is delayed with respect to path (42), coupler (44) recombines both pulses),

wherein at least one of said optical pulses is phase-modulated according to a quantum key distribution protocol (Fig. 1, pulse that traverses the bottom path is modulated by phase modulator (42) with information about the key);

at least one quantum channel for unidirectional-transmitting said optical pulses output from the transmitter side polarization-controlled encoder (Fig. 1, 3);

a receiver side polarization-controlled encoder for receiving said optical pulses from the quantum channel (Fig. 1, interferometer (5)),

splitting each of said optical pulses into two optical pulses which form a group and travel along two different paths (Fig. 1, splitter (50) splits the pulses into two paths),

relatively delaying said two optical pulses on the basis of said quantum key distribution protocol (Fig. 1, pulse that traverses path (52) is delayed with respect to path (51)), and

recombining said two optical pulses in one output path (coupler recombines both pulses),

wherein at least one of the received optical pulses, the split optical pulses, or, the delayed pulses is phase-modulated before recombined in one output path according to said quantum key distribution protocol (Fig. 1, pulse that traverses the top path is modulated by phase modulator (42)); and

a single photon detector for measuring at least one superposition interference of two pulses come from different groups and distributing a quantum key according to said quantum key distribution protocol (Fig. 1, single photon detectors (55 and 56) determine whether there is constructive or destructive interference (superposition) for determining the key.)

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims 11 and 12 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent 6,438,234 B1 to Gisin et al. and WIPO Publication WO 02/49267 A1 to Duraffourg et al. (U.S. Patent Application 2004/0086280 A1 to Duraffourg et al. is taken as a close translation.)

As to **Claim 11**, *Duraffourg* discloses a return photon separating and detecting unit (RPSDU) that is added in an output of a transmitter or in an input of a receiver (Fig. 5, circulator (6), filters (7, 10) and detector (11)),

said return photon separating and detecting unit comprises an optical circulator (Fig. 5, 6) and a single photon detector (Fig. 5, 11),

wherein an input port of said unit connects with an output port of said encoder (Fig. 5, input of RPSDU connected to the encoder at Alice via fiber (4)), and

an output port of said unit connects with said quantum channel (Fig. 5, output port towards the detector is connected to the quantum channel (4) via circulator (6), and

a reverse output port of said unit connects with an input port of said single photon detector (Fig. 5, output port connected to single photon detectors (11 and 8; ¶ 128 detectors are counting photons.)

Duraffourg and *Gisin* are from the same art with respect to optical communication and are therefore analogous art.

At the time of the invention, it would have been obvious for a person of ordinary skill in the art to use the RPSDU disclosed by *Duraffourg* in the system disclosed by *Gisin*. The suggestion/motivation would have been to enable the use of a 4 state protocol (¶ 128.)

As to **Claim 12**, *Duraffourg* discloses wherein said return photon separating and detecting unit further comprises a band pass filter arranged before the input of said circulator (Fig. 5, 7) The suggestion/motivation is the same as that used in the rejection for claim 11.

5. Claim 8 is rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent 6,438,234 B1 to Gisin et al. and U.S. Patent 7,555,127 B2 to Nambu et al.

As to **Claim 8**, *Gisin* discloses a polarization-maintained beam splitter for splitting an Optical pulse into two optical pulses traveling along two different paths and outputting one optical pulse directly (Fig. 2, interferometer (1) sends one pulse from source (10) directly to fiber (3) while another pulse is reflected once by each Faraday mirror (14) and (16));

a first mirror for reflecting another optical pulse back said polarization-maintained beam splitter and passing it through said polarization-maintained beam splitter (Fig. 2, 14, passes the pulse back to the beam splitter);

a second mirror for reflecting the pulse passed through said polarization-maintained beam splitter back, wherein said polarization-maintained beam splitter recombines the reflected pulse with the outputted pulse in one output path (Fig. 2, pulse reflected by mirror (14) is then reflected by mirror (16), this is transmitted with the direct pulse over fiber (3);

a polarization-maintained delay line arranged on the paths between the first and second mirrors (Fig. 2, the path through both mirrors is longer than the direct path, so the mirrored path has a delay line); and

a phase modulator arranged on at least one of said two different paths and said output path (Fig. 2, 13),

wherein said paths between the first and second mirrors are polarization-maintained paths (Col. 2, ll. 56-8, both interferometers preserve polarization.)

Gisin does not expressly disclose that the beam splitter is variable.

Nambu discloses a variable beam splitter (Fig. 3, 22 and Fig. 4) used in a QKD encoder.

Gisin and *Nambu* are from the same art with regard to optical communication, and are therefore analogous art.

At the time of the invention, it would have been obvious for a person of ordinary skill in the art to use the variable beam splitter disclosed by *Nambu* in

the system disclosed by *Gisin*. The suggestion/motivation would have been to be able to finely tune the splitter according to a desired ratio.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to DANIEL G. DOBSON whose telephone number is (571)272-9781. The examiner can normally be reached on Mon. - Fri. 8:00 AM - 5:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kenneth Vanderpuye can be reached on (571) 272-3078. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Daniel G. Dobson/

Examiner, Art Unit 2613
10/08/2009

/Kenneth N Vanderpuye/
Supervisory Patent Examiner, Art Unit 2613